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## PATENT COOPERATION TREATY

## PCT

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

REC'D 10 SEP 2004

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Applicant's or agent's file reference 7240156001-3224000	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/US03/22710	International filing date (day/month/year) 15 July 2003 (15.07.2003)	Priority date (day/month/year) 15 July 2002 (15.07.2002)
International Patent Classification (IPC) or national classification and IPC IPC(7): B32B 15/06, 15/16, 15/20, 25/02, 25/04, 25/20, 31/00; H05K 7/20 and US Cl.: 361/704, 717, 719; 428/332, 411.1, 447, 457, 500		
Applicant HONEYWELL INTERNATIONAL INC.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

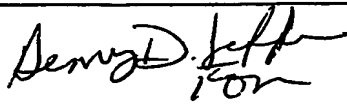
2. This REPORT consists of a total of 3 sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 5 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of report with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 20 January 2004 (20.01.2004)	Date of completion of this report 18 August 2004 (18.08.2004)
Name and mailing address of the IPEA/US Mail Stop PCT, Attn: IPEA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (703) 305-3230	Authorized officer Ramsey Zacharia  Telephone No. (703) 308-0661

Form PCT/IPEA/409 (cover sheet)(July 1998)

**I. Basis of the report****1. With regard to the elements of the international application:\***☐ the international application as originally filed.☒ the description:

pages 1-31 as originally filed

pages NONE, filed with the demand

pages NONE, filed with the letter of \_\_\_\_\_.

☒ the claims:

pages NONE, as originally filed

pages NONE, as amended (together with any statement) under Article 19

pages NONE, filed with the demand

pages 32-36, filed with the letter of 20 July 2004 (20.07.2004)

☐ the drawings:

pages NONE, as originally filed

pages NONE, filed with the demand

pages NONE, filed with the letter of \_\_\_\_\_.

☐ the sequence listing part of the description:

pages NONE, as originally filed

pages NONE, filed with the demand

pages NONE, filed with the letter of \_\_\_\_\_.

**2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.**

These elements were available or furnished to this Authority in the following language \_\_\_\_\_ which is:

☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).☐ the language of publication of the international application (under Rule 48.3(b)).☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).**3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:**☐ contained in the international application in printed form.☐ filed together with the international application in computer readable form.☐ furnished subsequently to this Authority in written form.☐ furnished subsequently to this Authority in computer readable form.☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.**4. ☒ The amendments have resulted in the cancellation of:**☐ the description, pages NONE☒ the claims, Nos. 3 and 25☐ the drawings, sheets/fig NONE**5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).\*\***

\* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

\*\* Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.

**V. Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement****1. STATEMENT**

Novelty (N)

Claims 1, 2, 4, 5, 7-24, 26, 27, 29-50 YES  
Claims NONE NO

Inventive Step (IS)

Claims 1, 2, 4, 5, 7-24, 26, 27, 29-50 YES  
Claims NONE NO

Industrial Applicability (IA)

Claims 1, 2, 4, 5, 7-24, 26, 27, 29-50 YES  
Claims NONE NO**2. CITATIONS AND EXPLANATIONS**

Claims 1, 2, 4, 5, 7-24, 26, 27, and 29-50 meet the criteria set out in PCT Article 33(2)-(3), because the prior art does not teach or fairly suggest using a hydroxy functional rubber compound as the interface material.

U.S. Patent 4,450,471 teaches a semi-conductor power device secured to a heat spreader. A bonding layer is present at the interface of the heat spreader and a base material. The bonding layer comprises an epoxy, a crosslinkable resin, loaded with conductive silver particles. The heat spreader is formed of copper. However, U.S. Patent 4,450,471 does not teach or fairly suggest using a hydroxy functional rubber compound in the bonding layer.

U.S. Patent 5,440,230 teaches a silicone rubber layer between and in thermal contact with an integrated circuit with a heat spreader but does not teach that the silicone rubber is a hydroxy functional rubber.

U.S. Patent 5,847,929 teaches a circuit board that is bonded to a heat spreader by means of an epoxy or silicone adhesive. The heat spreader may be made of copper or aluminum. The adhesive is filled with silver or copper particles. However, U.S. Patent 5,847,929 does not teach or fairly suggest using a hydroxy functional rubber compound in the adhesive layer.

Claims 1, 2, 4, 5, 7-24, 26, 27, and 29-50 meet the criteria set out in PCT Article 33(4), and thus have industrial applicability because the subject matter claimed can be made or used in industry.

----- NEW CITATIONS -----

## CLAIMS

We Claim:

1. A layered thermal component, comprising:  
  
at least one thermal interface component, wherein the thermal interface component comprises at least one rubber compound having at least one terminal hydroxyl group and at least one thermally conductive filler material; and  
  
at least one heat spreader component coupled to the thermal interface component.
2. The layered thermal component of claim 1, wherein the at least one thermal interface component comprises a crosslinkable material.
3. Canceled.
4. The layered thermal component of claim 2, wherein the at least one thermal interface component further comprises at least one crosslinker moiety, at least one crosslinking compound or at least one crosslinking resin.
5. The layered thermal component of claim 4, wherein the at least one crosslinker moiety, the at least one crosslinking compound or the at least one crosslinking resin comprises an amine resin or an amine-based compound.
6. Canceled.
7. The layered thermal component of one of claims 1 or 6, wherein the at least one rubber compound comprises at least one secondary, tertiary or otherwise internal hydroxyl group.
8. The layered thermal component of claim 1, wherein the at least one thermal interface component comprises at least one solder material.
9. The layered thermal component of claim 8, wherein the at least one solder material comprises a paste.
10. The layered thermal component of claim 8, wherein the at least one solder material comprises at least one of the following: indium, copper, silver, aluminum, gallium, tin or bismuth.

11. The layered thermal component of claim 8, wherein the at least one thermal interface component further comprises at least one resin component.
12. The layered thermal component of claim 11, wherein the at least one resin component comprises a silicone compound.
13. The layered thermal component of claim 12, wherein the silicone compound comprises a vinyl Q resin or a vinyl silicone.
14. The layered thermal component of claim 11, wherein the at least one solder material comprises at least one of the following: indium, tin, silver, bismuth or aluminum.
15. The layered thermal component of claim 11, further comprising a crosslinking additive.
16. The layered thermal component of claim 15, wherein the crosslinking additive comprises a siloxane compound.
17. The layered thermal component of claim 16, wherein the siloxane compound comprises a hydride functional siloxane compound.
18. The layered thermal component of claim 1, wherein the at least one heat spreader component comprises at least one metal or metal-based base material.
19. The layered thermal component of claim 18, wherein the at least one metal or metal-based base material comprises nickel, aluminum or copper.
20. The layered thermal component of claim 19, wherein the at least one metal or metal-based base material comprises AlSiC.
21. The layered thermal component of claim 1, wherein the at least one heat spreader component has a thickness of about 0.25 mm to about 6 mm.
22. The layered thermal component of claim 21, wherein the at least one heat spreader component has a thickness of about 1 mm to about 5 mm.
23. A method of forming a layered thermal component, comprising:  
providing at least one thermal interface component, wherein the thermal interface component comprises at least one rubber compound having at least one terminal hydroxyl group and at least one thermally conductive filler material;

providing at least one heat spreader component; and

coupling the at least one thermal interface component to the at least one heat spreader component.

24. The method of claim 23, wherein the at least one thermal interface component comprises a crosslinkable material.
25. Canceled.
26. The method of claim 24, wherein the at least one thermal interface component further comprises at least one crosslinker moiety, at least one crosslinking compound or at least one crosslinking resin.
27. The method of claim 26, wherein the at least one crosslinker moiety, the at least one crosslinking compound or the at least one crosslinking resin comprises an amine resin or an amine-based compound.
28. Canceled.
29. The method of one of claims 23 or 28, wherein the at least one rubber compound comprises at least one secondary, tertiary or otherwise internal hydroxyl group.
30. The method of claim 23, wherein the at least one thermal interface component comprises at least one solder material.
31. The method of claim 30, wherein the at least one solder material comprises a paste.
32. The method of claim 30, wherein the at least one solder material comprises at least one of the following: indium, copper, silver, aluminum, gallium, tin or bismuth.
33. The method of claim 30, wherein the at least one thermal interface component further comprises at least one resin component.
34. The method of claim 33, wherein the at least one resin component comprises a silicone compound.
35. The method of claim 34, wherein the silicone compound comprises a vinyl Q resin or a vinyl silicone.

36. The method of claim 33, wherein the at least one solder material comprises at least one of the following: indium, tin, silver, bismuth or aluminum.
37. The method of claim 33, further comprising a crosslinking additive.
38. The method of claim 37, wherein the crosslinking additive comprises a siloxane compound.
39. The method of claim 38, wherein the siloxane compound comprises a hydride functional siloxane compound.
40. The method of claim 23, wherein the at least one heat spreader component comprises at least one metal or metal-based base material.
41. The method of claim 40, wherein the at least one metal or metal-based base material comprises nickel, aluminum or copper.
42. The method of claim 41, wherein the at least one metal or metal-based base material comprises AlSiC.
43. The method of claim 23, wherein the at least one heat spreader component has a thickness of about 0.25 mm to about 6 mm.
44. The method of claim 43, wherein the at least one heat spreader component has a thickness of about 1 mm to about 5 mm.
45. An electronic component comprising the layered thermal component of claim 1.
46. A semiconductor component comprising the layered thermal component of claim 1.
47. An electronic component comprising the layered thermal component of claim 23.
48. A semiconductor component comprising the layered thermal component of claim 23.
49. A method for forming the thermal interface component of claim 1 or claim 23, comprising:
  - providing at least one saturated rubber compound;
  - providing at least one amine resin;
  - crosslinking the at least one saturated rubber compound and the at least one amine resin to form a crosslinked rubber-resin mixture;

adding at least one thermally conductive filler to the crosslinked rubber-resin mixture;  
and

adding a wetting agent to the crosslinked rubber-resin mixture.

50. The method of claim 49, further comprising adding at least one phase change material to the thermal interface material.